Delta Risk Management Strategy

for the

Levees in the Sacramento-San Joaquin Delta

Project Scope

FINAL DRAFT

Prepared by:

California Department of Water Resources
United States Army Corps of Engineers
California Department of Fish and Game

In conjunction with:

California Bay-Delta Authority
The Delta Risk Management Strategy Steering Committee

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Project Scope

1. Introduction

There are approximately 1,115 miles of levees protecting 700,000 acres of lowland in the Sacramento-San Joaquin Delta. In the Suisun Marsh, there are approximately 230 miles of levees protecting over 50,000 acres of marsh land. Only about a third of the Delta levees (385 miles) are Project Levees which were part of an authorized federal flood control project of the Sacramento and San Joaquin River systems and eligible for Corps of Engineers rehabilitation. However, the vast majority of Delta levees, over 730 miles, and all of the Suisun Marsh levees are non-project (local) levees. Local levees were constructed, enlarged, and maintained over the last 130 years by local reclamation districts. In general, the levee work by these districts was financed by the owners of the lands within the levees. In the last 30 years or so, the State of California has provided supplemental financing for levee maintenance and emergency response.

Many of the local levees in the Delta started out as 3 to 5-foot-high dikes of peat over a century ago. Modern engineering analyses and techniques were not available during the initial construction of the levees which generally rest on the original marsh soils. Over time, the weight of the levees compressed and displaced the soft, organic soils beneath them. In addition, the organic soils within the island interiors oxidized and were removed by wind over time, resulting in the land surface significantly subsiding. As a result, the levees have to be continually raised and broadened, which commonly initiates further settlement, embankment cracking, and loss of freeboard. This process will continue until the levees and their foundations stabilize, and many reaches have not yet stabilized to date. Delta levees today are now commonly 15 to 20 feet high, and often protect island interiors that are 10 to 15 feet below sea level. Permeable lenses in the levee and foundation, together with historic relics, such as abandoned pipes, and constant burrowing by various mammals also commonly result in seepage distress and internal erosion.

During the last century, there have been 162 Delta levee failures leading to island inundations. In many cases, the flooding of the islands has been extremely costly to both local residents and farmers, and to the State as a whole. Levee failures in the Suisun Marsh have also occurred with significant impacts to local and statewide interests. In February 1998, 11 exterior levee breaches in the Suisun Marsh resulted in the inundation of over 22,000 acres and threatened both the State Water Project and Central Valley Project facilities.

California has an immense interest in maintaining many of the Delta and Suisun Marsh levees, in part because the Delta is a source of drinking water for about two out of every

three Californians. In addition, there are important critical environmental, agricultural, and recreational benefits in the region. There are also extensive infrastructure and capitol investments in the Delta, ranging from houses, businesses, and towns to State highways, rail lines, natural gas fields, gas and fuel pipelines, and drinking water pipelines (e.g. Mokelumne Aqueduct) and two deepwater ports.

2. Delta Levee Program

In 1988, the State Legislature enacted SB 34 which established the Delta Flood Protection Program and procedures to provide levee maintenance, flood control, and environmental mitigation for numerous reclamation districts throughout the Sacramento-San Joaquin Delta. The program has been generally administered by the California Department of Water Resources, but it also has required the California Department of Fish and Game to ensure that there would be no long-term habitat loss. SB 1065, enacted in 1991, provided funding for environmental mitigation projects, and required the preparation of a memorandum of understanding between CDWR, CDFG, the Resources Agency, and the State Reclamation Board to coordinate the work of the agencies' carrying out this program.

Recognizing that the Program needed to provide ecosystem enhancement in addition to mitigation, the Program was modified with the passage of AB 360 in 1996. This current law requires the Program to achieve no net loss and long-term fish and wildlife habitat improvement in conjunction with the levee work perform by reclamation districts funded by the Program.

With the subsequent creation of CALFED, the Delta Flood Protection Program was made part of the overall CALFED Program and renamed the CALFED Levee System Integrity Program. In addition to maintaining and improving the Delta levee system, the Program contributes to the goals of CALFED's Ecosystem Restoration and Science Programs. The two local assistance funding mechanisms in this program, Delta Levee Subventions and Special Projects, are considered critically important in helping to maintain the levee and habitat systems in the Delta.

3. Future Risks

Although the areal extent and rate of subsidence of Delta islands have reduced in recent years, subsidence is still continuing in many areas. This requires continued enlargement of the levee system and adds to both the risk and consequence of levee failure. The potential for sea level rise and greater peak river flows caused by global warming also represent greater future risks, albeit somewhat unknown at this point. Moreover, a major earthquake occurring close to the Delta has the potential of creating extensive levee failures and multiple island inundations.

Major levee failures are difficult and expensive to repair. The recent 2004 dry weather failure of a levee along Middle River and the flooding of 12,000 acres on Upper and

Lower Jones Tracts induced damages that will exceed more than $100 million. Multiple simultaneous levee failures caused by storm or earthquake would have a devastating physical and financial impact on the entire state. All CALFED/CBDA programs would be significantly and negatively impacted, and some events may result in negative impacts so great that we will not be able to fully recover the infrastructure and ecosystems we value so dearly today. We need to plan boldly now to reduce the risk of future devastation to manageable proportions.

4. Delta Risk Management Strategy

The 2000 CALFED Record of Decision presented its Preferred Program Alternative that described actions, studies, and conditional decisions to help fix the Delta. Included in the Preferred Program Alternative for a Stage 1 implementation was the completion of a Delta Risk Management Strategy that would assess major risks to the Delta resources from floods, seepage, subsidence and earthquakes. It would also evaluate the consequences, and develop recommendations to manage the risk (see pages 17 and 74 of the CALFED Record of Decision of 2000).

The current study being initiated is an outgrowth of the risk management program element described in the Record of Decision. It is intended to accomplish the goals originally set forth in the Record of Decision for the risk management strategy, and to provide a set of alternative risk reduction plans that would be considered in subsequent decision/implementation phases. Risk reduction measures that would be common to all alternative plans would be recommended for immediate implementation.

The Delta Risk Management Strategy is being jointly conducted by the California Department of Water Resources and the United States Army Corps of Engineers in conjunction with the California Department of Fish and Game. Under the Record of Decision, the CDWR and USACE are the implementing agencies for the Levee program. Under the California Bay Delta Authority Act of 2003, CDWR, CDFG, and the USACE became the implementing agencies for the Levee Program. All three CALFED agencies coordinate their efforts with the California Bay Delta Authority. The CBDA is an oversight and coordination agency that will be working with the CDWR, CDFG, and the USACE to ensure that the Risk Management Strategy is conducted in such a way that meets the CALFED Program objectives. There is expected to be significant coordination and input from CALFED and its agencies.

5. Objectives of the Delta Risk Management Strategy

The objectives of the Delta Risk Management Strategy are as follows:

- Evaluation and documentation of ongoing and future risk of levee failure over the next **50** years (flooding, subsidence, earthquake).

- Identification and documentation of probable consequences following levee failures (e.g. ecosystem functions and values, water quality and supply, agriculture, recreation/navigation, infrastructure, life and property). This would include identifying both qualitative and quantitative (e.g. fiscal impacts) by island, and which entities would sustain them. This would include an evaluation of impacts if the island(s) remain flooded after a levee failure.

- Identification of highest risk regions and islands, together with islands having the highest potential impacts to resources and beneficial uses should abrupt levee failures and island inundations occur.

- Identification of levee maintenance, upgrades, and ecosystem enhancement components that are economically feasible and consistent with risk reduction plans.

- Establish potential priorities for near-term and long-term levee maintenance, by island.

- Identify land use and plan form changes that could reduce the risk of levee failure and/or the consequential impacts of abrupt flooding on resources and beneficial uses in the Delta.

- Develop a communications strategy for both the evaluation and implementation phases:
  - Develop and implement processes to inform the public of the evaluation and its implications.
  - Develop recommended elements of a plan for informing all parties during a future implementation phase.

- Identify near-term actions and land use changes that could be implemented in the near term to mitigate/prevent further levee degradation and reduce risk (e.g. cease farming on Sherman and Twitchell Islands, purchase Decker Island, proceed with Franks Tract, etc…). **Develop these for early implementation**.

- Evaluation of alternative risk reduction plans, including ecosystem enhancement alternatives, and evaluation of potential elements that would be common to most, if not all, alternative risk reduction plans. Included in this evaluation would be

the costs of measures and plans, together with the risk reductions and benefits, including those to ecosystems, that would result.

- Identify long-term actions and identify implementation actions needed early on to avoid bottlenecks later (e.g. prioritizing and purchasing key islands, revising approach to Suisun March, identifying funding mechanisms, ecosystem enhancements that complement risk reduction strategies)

- Development of a Plan of Action for Future Steps
  - Recommend Alternative Risk Reduction Plans for Consideration
  - Identify common elements that should be implemented

6. Risk/Hazard Analyses

A. Seismic

- Phase I

- Phase II – including an overall risk envelope of earthquake events

B. Flood (including climate change, sea-level rise)

C. Dry Weather/Sudden Unexpected (e.g. 2004 Jones Tract)

7. Hydrodynamic Analyses

- Hydrodynamic model outputs include: Circulation, residence time, temperature and tidal amplitude, excursion, mixing, transport, and range.

8. Effects on Resources and Beneficial Uses (consequences of alternatives)

- Ecosystem
- Water Supply
- Infrastructure
- Life and Property
- Agriculture
- Recreation
- Navigation

For each resource/beneficial use, conclusions as to the effects of events or actions may need to be supported by a brief conceptual model showing assumptions about changes in state, and alternation of process. Where feasible, the model should illuminate areas of good knowledge, as well as uncertainty, and the needs for further information and analysis to buttress conclusions.

9. Analytical Tools and Efforts

A. GIS
B. Seismic risk model
C. Other risk models/analyses
D. Levee breach models
E. Estuary hydrodynamic models (particle, temperature, salinity, sediment, etc…)
F. Economic models
G. Habitat, ecosystem element and species life history conceptual models
H. Adaptive management models
I. Climate models
J. California water operations simulation models
K. Potential focused analyses on the impacts of:
    i. Residence time
    ii. Temperature
    iii. Carbon flux/Food web
    iv. Exotic species
    v. Listed species
    vi. Salinity
    vii. Vectors
    viii. Habitat
    ix. Fish migration
    x. Predator/prey relationships
    xi. Water Quality (THM formation potential, DO, DOC, salinity, mercury bioavailability, etc…)
    xii. Land use changes
    xiii. Levee maintenance
    xiv. Social issues
L. Potential focused analyses needed to advance risk reduction measures:
    i. Geotechnical design improvements for Levees
    ii. Subsidence reversal techniques
    iii. Beneficial reuse of dredged material
    iv. Gate and barrier facilities
    v. Emergency response planning
    vi. Ecosystem benefits
    vii. Environmental justice
    viii. Land use changes and planning
    ix. Pre-flooding of islands
    x. Desirable habitat changes
    xi. Costs

10. Alternative Risk Reduction Strategies

A. Levee Structural Improvements
B. Improved Levee Maintenance
C. Plan-form Changes – new configurations
D. Ecosystem enhancement components such as expanded tidal wetlands
E. Improved emergency response capabilities
F. Subsidence reduction
G. Subsidence reversal
H. Land use changes adjacent to levees
I. Island land use changes
J. Pre-flooding of islands
K. Water operations
L. Permanent, operable barriers
M. Temporary barriers
N. New facilities

11. Fields of Expertise Required

- Engineering management
- Risk and Decision Analysis
- Process Facilitation
- Seismology
- Geomorphology
- Hydraulics/Hydrology
- Tidal Processes
- Water Quality (THM & Hg)
- Land Use
- Terrestrial Biology
- Exotic Species
- Habitat Restoration
- Climate Change
- Socio-Economics
- Simulation Modeling
- Public Processes and Policy
- Geotechnical Earthquake Engineering
- Delta Levee Engineering
- Subsidence/Seepage
- Sediment Transport
- Transportation and Navigation
- Recreation
- Aquatic Biology and Fisheries
- Avian & Waterfowl Science
- Vector Management
- Delta & Statewide Water Operations
- Economic Impact Analysis
- Financing

12. DRMS Implementation Process – *Two Year Process*

A. Scoping Process for Project Plan
- CDWR and USACE Co-leads with CDFG
- ***DRMS SteeringCommittee***
- ***DRMS Technical Advisory Committee***
- CALFED and Bay Delta Public Advisory Committee – ERP, Water Quality, Conveyance, Environmental Justice, Levee Subcommittees
- CALFED Science Boards (Independent, Ecosystem, Water Man., Levee, etc.)
- SRCD, Delta Protection Commission, CBDA staff, State, Federal (USFWS, NOAA Fisheries) and local agencies, various stakeholders and interest groups

B. Develop Proposed Project Plan
- Technical Advisory Committee

C. Obtain CALFED executive concurrence on Proposed Project Plan

D. Obtain public comments on Proposed Project Plan and Finalize

E. Implement RFQ/RFP process and complete contracts for following services:
- Risk/Hazard Analysis
- Various Resource Consultants for Impacts and Improvements
- Various Engineering Consultants for Impacts and Improvements
- Individual ***Technical Advisory Committee*** members

F. Carry out Comprehensive Program Evaluation over 2 Years
- Iterative Process
- Program Milestone Reviews
- Continued participation by CALFED BDPAC Levee Subcommittee, ***DRMS Steering Committee***, and ***DRMS Technical Advisory Committee***

G. Prepare Draft Report Documenting Alternative Risk Reduction Plans

H. Obtain comments on Draft Report

I. Finalize Report

13. DRMS Work Groups

A. DRMS Agency Managers/Staff

Management of the work for completing the Delta Risk Management Strategy will be done by the CDWR, USACE, and CDFG (Lead Agencies) by the following individuals:

1. Dr. Leslie F. Harder, Jr., Division of Flood Management, Department of Water Resources
2. Curt Schmutte, Division of Flood Management, Department of Water Resources
3. Judy Soutiere, United States Corps of Engineers, Sacramento District
4. Michael Ramsbotham, United States Corps of Engineers, Sacramento District
5. Marina Brand, California Department of Fish and Game
6. Sergio Guillen, California Bay Delta Authority

Additional Agency staff will be added to the DRMS management team as needed.

B. Technical Advisory Committee:

A Technical Advisory Committee will be formed and will comprise the following individuals:

1. Dr. Raymond Seed, University of California, Berkeley
2. Dr. Norm Abrahamson, Independent Seismological Consultant
3. Gilbert Cosio, MBK Engineers
4. Dr. Wim Kimmerer, San Francisco State University, ERP Science Board
5. Dr. Peter Moyle, University of California, Davis, ERP Science Board
6. Roger Fuji, United States Geological Survey
7. Jon Bureau, United States Geological Survey

The purpose of the TAC will be to help develop the Project Plan with Agency assistance, and to periodically review the work of consultants in order to assure that the work is being completed using appropriate scientific approaches. TAC meetings will be convened by Agency management. Technical review reports will be completed by the TAC and submitted to DRMS management as requested.

13. DRMS Work Groups (continued)

C. DRMS Steering Committee

The DRMS Steering Committee was responsible for helping establish the current Scope of Work for the Delta Risk Management Strategy. It is envisioned that the DRMS Steering Committee will continue to participate in the process to review policy and overall direction of the studies at appropriate milestones. The DRMS Steering Committee will include members from the DRMS Technical Advisory Committee as well as Agency managers and other stakeholders:

1. Dr. Leslie F. Harder, Jr., Division of Flood Management, California Department of Water Resources
2. Curt Schmutte, Division of Flood Management, California Department of Water Resources
3. Judy Soutiere, United States Corps of Engineers, Sacramento District
4. Michael Ramsbotham, United States Corps of Engineers, Sacramento District
5. Marina Brand, California Department of Fish and Game
6. Sergio Guillen, California Bay Delta Authority
7. Marci Coglianese, Bay Delta Public Advisory Board, Levee Subcommittee Co-Chair
8. Tom Zuckerman, Bay Delta Public Advisory Board, Levee Subcommittee Co-Chair
9. Dennis Majors, State Water Contractors /*Alt.: Laura King Moon, State Water Contractors*
10. **?**, United States Bureau of Reclamation, Mid-Pacific Region
11. Frances Mizuno, San Luis and Delta-Mendota Water Authority
12. Gary Bobker, Bay Institute
13. Dr. Robert Twiss, University of California, Berkeley; CALFED ERP Science Board
14. Dr. Raymond Seed, University of California, Berkeley, *DRMS Technical Advisory Committee*
15. Dr. Norm Abrahamson, Independent Seismological Consultant, , *DRMS Technical Advisory Committee*
16. Gilbert Cosio, MBK Engineers, *DRMS Technical Advisory Committee*
17. Dr. Wim Kimmerer, San Francisco State University, ERP Science Board, *DRMS Technical Advisory Committee*
18. Dr. Peter Moyle, University of California, Davis, ERP Science Board, *DRMS Technical Advisory Committee*
19. Roger Fuji, United States Geological Survey, *DRMS Technical Advisory Committee*
20. Jon Bureau, United States Geological Survey, *DRMS Technical Advisory Committee*